CLAIMS:

1. An isolated nucleic acid fragment comprising or complementary to a nucleotide sequence encoding a polypeptide having desaturase activity, wherein the amino acid sequence of said polypeptide has at least 50% sequence identity to an amino acid sequence selected from the group consisting of SEQ ID NO:20, SEQ ID NO:29, SEQ ID NO:31, SEQ ID NO:33 and SEQ ID NO:35.

2. An isolated nucleotide sequence comprising or complementary to at least about 50% of the nucleotide sequence selected from the group consisting of SEQ ID NO:13, SEQ ID NO:19, SEQ ID NO:28, SEQ ID NO:30, SEQ ID NO:32 and SEQ ID NO:34.

3. The isolated nucleotide sequence of claim 2 wherein said sequence is selected from the group consisting of SEQ ID NO:13, SEQ ID NO:19, SEQ ID NO:28, SEQ ID NO:30, SEQ ID NO:32 and SEQ ID NO:34.

4. The isolated nucleotide sequence of claim 2 or 3 wherein said sequence encodes a functionally active desaturase which utilizes a polyunsaturated fatty acid as a substrate.

5. The nucleotide sequence of claim 4 wherein SEQ ID NO:13 and SEQ ID NO:19 are derived from *Saprolegnia diclina*.

6. The nucleotide sequence of claim 5 wherein

SEQ ID NO:28, SEQ ID NO:30 and SEQ ID NO:32 are derived from *Thraustochytrium aureum*.

7. The nucleotide sequence of claim 6 wherein SEQ ID NO:34 is derived from *Isochrysis galbana*.

8. A purified polypeptide encoded by said nucleotide sequence of claim 1, 2 or 3.

9. A purified polypeptide which desaturates polyunsaturated fatty acids at carbon 5 and has at least about 50% amino acid identity to an amino acid sequence selected from the group consisting of SEQ ID NO:20, SEQ ID NO:29, SEQ ID NO:31 and SEQ ID NO:35.

10. A purified polypeptide which desaturates polyunsaturated fatty acids at carbon 6 and has at least about 50% amino acid identity to an amino acid sequence selected from the group consisting of SEQ ID NO:33 and SEQ ID NO:14.

11. A method of producing a desaturase comprising the steps of:

a) isolating a nucleotide sequence selected from the group consisting of SEQ ID NO:13, SEQ ID NO:19, SEQ ID NO:28, SEQ ID NO:30, SEQ ID NO:32 and SEQ ID NO:34;

b) constructing a vector comprising: i) said isolated nucleotide sequence operably linked to ii) a regulatory sequence;

c) introducing said vector into a host cell for a time and under conditions sufficient for expression of said desaturase.

12. A vector comprising: a) a nucleotide sequence selected from the group consisting of SEQ ID NO:13, SEQ

ID NO:19, SEQ ID NO:28, SEQ ID NO:30, SEQ ID NO:32 and SEQ ID NO:34, operably linked to b) a regulatory sequence.

13. A host cell comprising said vector of claim 12.

14. A mammalian cell comprising said vector of claim 12, wherein expression of said nucleotide sequence of said vector results in production of altered levels of AA, EPA, GLA or STA, when said cell is grown in a culture media comprising at least one fatty acid selected from the group consisting of LA, ALA, DGLA and ESP.

15. A plant cell, plant or plant tissue comprising said vector of claim 12, wherein expression of said nucleotide sequence of said vector results in production of a polyunsaturated fatty acid by said plant cell, plant or plant tissue.

16. The plant cell, plant or plant tissue of claim 15 wherein said polyunsaturated fatty acid is selected from the group consisting of AA, EPA, GLA and STA.

17. One or more plant oils or acids expressed by said plant cell, plant or plant tissue of claim 15.

18. A transgenic plant comprising said vector of claim 12, wherein expression of said nucleotide sequence of said vector results in production of a polyunsaturated fatty acid in seeds of said transgenic plant.

19. A method for producing a polyunsaturated fatty acid comprising the steps of:

a) isolating a nucleotide sequence selected from the group consisting of SEQ ID NO:19, SEQ ID NO:28, SEQ ID NO:30 and SEQ ID NO:34;
b) constructing a vector comprising said isolated nucleotide sequence;
c) introducing said vector into a host cell for a time and under conditions sufficient for expression of Δ5-desaturase enzyme; and
d) exposing said expressed Δ5-desaturase enzyme to a substrate polyunsaturated fatty acid in order to convert said substrate to a product polyunsaturated fatty acid.

20. The method according to claim 19, wherein said substrate polyunsaturated fatty acid is DGLA or 20:4n-3 and said product polyunsaturated fatty acid is AA or EPA, respectively.

21. The method according to claim 19 further comprising the step of exposing said product polyunsaturated fatty acid to an elongase in order to convert said product polyunsaturated fatty acid to another polyunsaturated fatty acid.

22. The method according to claim 21 wherein said product polyunsaturated fatty acid is AA or EPA and said another polyunsaturated fatty acid is adrenic acid or (n-3)-docosapentaenoic acid, respectively.

23. The method of claim 21 further comprising the step of exposing said another polyunsaturated fatty acid to an additional desaturase in order to convert said another polyunsaturated fatty acid to a final polyunsaturated fatty acid.

24. The method of claim 23 wherein said final

polyunsaturated fatty acid is (n-6)-docosapentaenoic acid or docosahexaenoic (DHA) acid.

25. A method for producing a polyunsaturated fatty acid comprising the steps of:
a) isolating a nucleotide sequence selected from the group consisting of SEQ ID NO:13 and SEQ ID NO:32;
b) constructing a vector comprising said isolated nucleotide sequence;
c) introducing said vector into a host cell for a time and under conditions sufficient for expression of $\Delta 6$-desaturase enzyme; and
d) exposing said expressed $\Delta 6$-desaturase enzyme to a substrate polyunsaturated fatty acid in order to convert said substrate to a product polyunsaturated fatty acid.

26. The method according to claim 25, wherein said substrate polyunsaturated fatty acid is LA or ALA and said product polyunsaturated fatty acid is GLA or STA, respectively.

27. The method according to claim 25 further comprising the step of exposing said product polyunsaturated fatty acid to an elongase in order to convert said product polyunsaturated fatty acid to another polyunsaturated fatty acid.

28. The method according to claim 27 wherein said product polyunsaturated fatty acid is GLA or STA and said another polyunsaturated fatty acid is DGLA or ETA, respectively.

29. The method of claim 27 further comprising the step of exposing said another polyunsaturated fatty acid to an additional desaturase in order to convert

said another polyunsaturated fatty acid to a final polyunsaturated fatty acid.

30. The method of claim 29 wherein said final polyunsaturated fatty acid is AA or EPA.

31. A composition comprising at least one polyunsaturated fatty acid selected from the group consisting of said product polyunsaturated fatty acid produced according to the method of claim 19 or 25, said another polyunsaturated fatty acid produced according to the method of claim 21 or 27, and said final polyunsaturated fatty acid produced according to the method of claim 23 or 29.

32. The composition of claim 31 wherein said product polyunsaturated fatty acid is at least one polyunsaturated fatty acid selected from the group consisting of AA, EPA, GLA and STA.

33. The composition of claim 31 wherein said another polyunsaturated fatty acid is at least one polyunsaturated fatty acid selected from the group consisting of adrenic acid, (n-3)-docosapentaenoic acid, DGLA and EPA.

34. The composition of claim 31 wherein said final polyunsaturated fatty acid is at least one polyunsaturated fatty acid selected from the group consisting of (n-6)-docosapentaenoic acid, docosahexaenoic (DHA) acid, AA and EPA.

35. A method of preventing or treating a condition in a patient caused by insufficient intake of polyunsaturated fatty acids comprising administering

to said patient said composition of claim 31 in an amount sufficient to effect said prevention or treatment.